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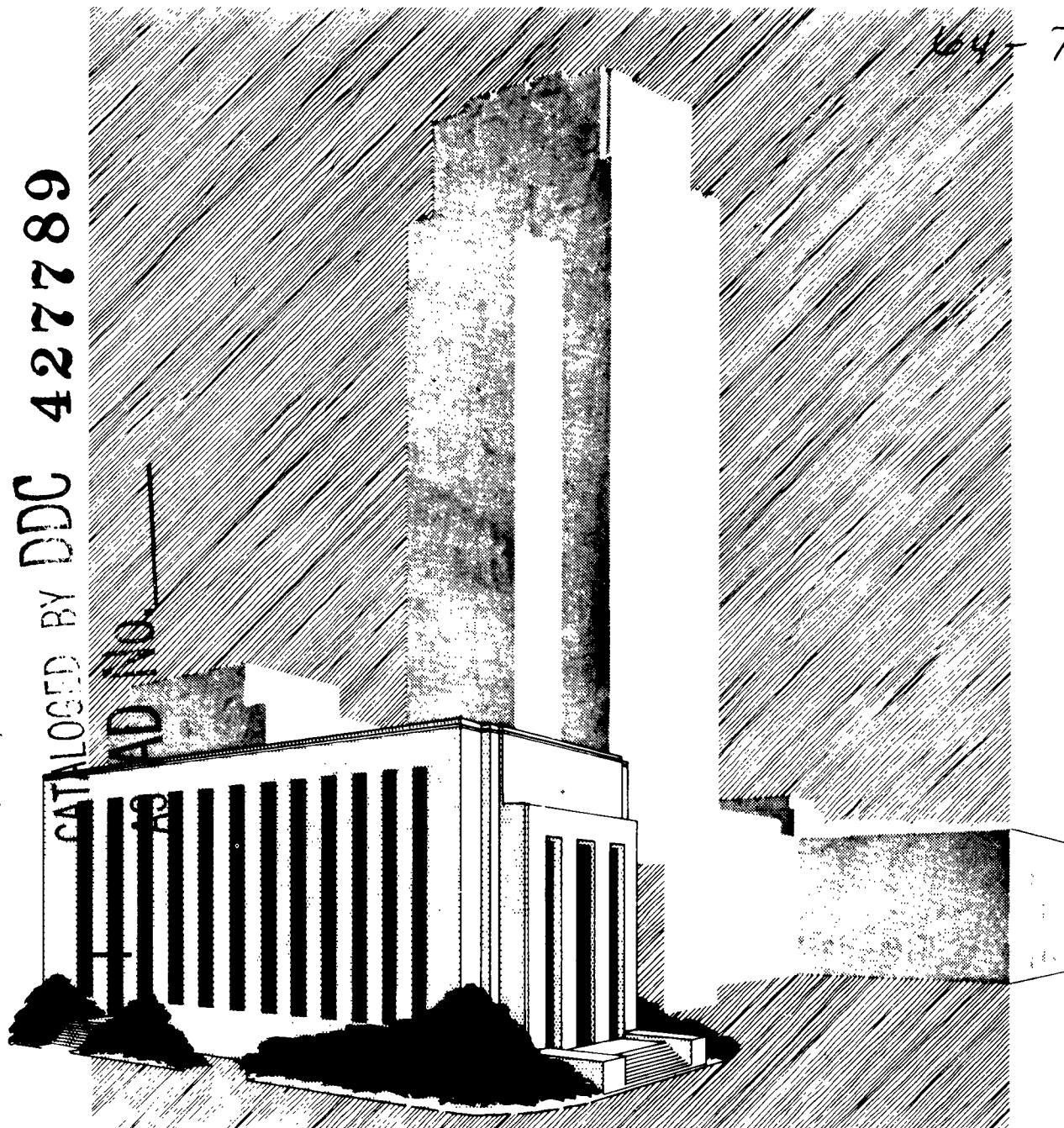
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A PORTABLE DENTAL  
STERILIZING CYLINDER

Research Report

## INTRODUCTION

The most reliable medium recommended for the sterilization of dental instruments is superheated steam.<sup>1</sup> However, superheated steam cannot be employed under emergency field conditions that do not permit the use of conventional equipment such as autoclaves; nor can it be used to sterilize dental instruments that will corrode if placed in water. Currently, no accepted method of sterilizing dental instruments will both satisfy emergency conditions and safeguard corrosion-susceptible instruments.

Chemical sterilization with ethylene oxide gas has been shown to be less damaging to many types of materials than any known method of sterilization,<sup>2</sup> but the gas is extremely flammable and must be mixed with an inert gas such as carbon dioxide or dichlorodifluoromethane (Freon-12\*). When it is mixed with 90 per cent carbon dioxide or 88 per cent Freon, ethylene oxide gas is safe and will not burn.<sup>3</sup>

The advantage of the Freon mixture is that it may be packaged in small containers at low pressures of 3 to 5 atmospheres.

Temperature is an important factor in sterilization with ethylene oxide. At room temperature an exposure time of as long as 16 hours may be required,<sup>4</sup> but the time can be reduced by increasing the temperature. Phillips<sup>5</sup> reported a reduction in sterilization time by a factor of 2.74 for each 10° C. rise in temperature between the range of 5° and 37° C. Sterilizers utilizing ethylene oxide at elevated temperatures are available commercially, but the smallest units on the market are expensive and not easy to employ under emergency conditions.

The purpose of our study was to fabricate a device that could be used to sterilize dental instruments rapidly, that could be employed under emergency field conditions, and that would protect the instruments being sterilized.

## MATERIALS AND METHODS

A sterilizer (fig. 1A) was made from an aluminum tube approximately 9 inches in length and having an outside diameter of 1 3/4 inches and an inside diameter of 1 1/2 inches. The tube was sealed at both ends by aluminum threaded plugs 3/4-inch thick. These plugs were fitted with plastic gaskets made from silicone rubber (Silastic RTV 502†). Each plug was vented by means of a small brass petcock. When sealed, the cylinder was found to be capable of withstanding at least 7 p.s.i. internal pressure without leaking.

To operate the sterilizer, one of the end plugs was removed (fig. 1B), and clean, dry instruments were inserted in the cylinder. After the plug had been replaced and tightened sufficiently to prevent leaking, an ethylene oxide container was connected to one of the opened petcocks (fig. 2), and gas was flushed through the cylinder for about 10 seconds to ensure replacement of the air by the sterilizing gas. Both petcocks were then closed tightly, and the cylinder was immersed in boiling water for 1 hour (fig. 3). The ethylene

\* Freon is the trademark for fluorinated chlorohydrocarbons produced by E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

† The Dow Corning Corp., Midland, Mich.

oxide gas mixture selected for this study was an experimental mixture containing 19 per cent ethylene oxide and 81 per cent Freon-12.

To determine the effect of the procedure on dental instruments likely to corrode, several tungsten carbide (high carbon) steel burs, carbide steel chisels, and scalpel blades were put through the sterilizing system 12 times.

The sterilizing effectiveness of the procedure was tested using corrosion-

resistant stainless steel explorers, carvers, and knives that had been contaminated by swabbing with a suspension of Bacillus subtilis (globigii) spores. These contaminated instruments, along with bacterial spore strips (Spordex\*), were placed in the sterilizing cylinder, subjected to the sterilizing system, and then transferred to test tubes containing beefheart infusion broth as a culture medium. After incubation at 37° C. for 2 days, the broth contained in each tube was examined to determine whether there had been any bacterial growth.

## RESULTS

No visible corrosion or alteration of the steel burs and instruments was noted after 12 sterilizing procedures.

Contaminated instruments and spore strips were successfully sterilized by

the procedure employed, as evidenced by the absence of bacterial growth after the instruments had been placed in broth and incubation at 37° C. had proceeded for 2 days.

## DISCUSSION

The conditions under which these experiments were conducted and the materials used were intended primarily to test the sterilizing cylinder. These conditions and materials are not necessarily those that would be employed under routine use. This is particularly true of the ethylene oxide-Freon mixture, which contained a higher concentration of ethylene oxide gas than might normally be considered safe to handle. Thus, it will be necessary to repeat these procedures employing other ethylene oxide mixtures, such as: (1) 10 per cent ethylene oxide and 90 per cent carbon dioxide (Carboxide Gas†); (2) 11 per cent ethylene oxide and 89 per cent halogenated hydrocarbons (Cryoxside Gas\*); and

(3) 12 per cent ethylene oxide and 88 per cent inert gases (Steroxside Gas‡).

The minimum sterilizing time for the system was not established and should be determined. It is possible that a heating period shorter than 1 hour may be employed, especially if the items are not to be used immediately and are kept in the cylinder.

The cost of constructing the sterilizing cylinder is an important item in its evaluation. An exact estimate is difficult to make because of the lack of figures on labor costs. Most of the materials, however, can be obtained through the Federal Supply Catalog

\* American Sterilizer Co., Erie, Pa.

† Carbide and Carbon Chemicals Corp., New York, N.Y.

‡ Wilmot Castle Co., Rochester, N.Y.

(see table 1) and should cost less than \$2 for each cylinder. The gas used for each sterilizing procedure should cost less than 25 cents.

Table 1. Materials for fabricating dental sterilizing cylinder.

Description	Federal Supply Catalog Stock Number
Cock, Shut Off, Screw Stem. O.D. = 1/4 inch	9C 4820-254-8640
Tube, Aluminum Alloy O.D. = 1.75 inches	9C 4710-542-2885
Rod, Aluminum Alloy O.D. = 1 7/8 inches	G 9530-233-1335

### SUMMARY

1. The report describes an aluminum cylinder in which dental instruments could be sterilized under emergency field conditions and at the same time be protected against corrosion. The procedure involves loading the cylinder with dental instruments, flushing it with ethylene oxide-Freon gas, closing it, and then immersing it in boiling water for 1 hour.

2. In preliminary experiments with a prototype of the sterilizing cylinder, dental instruments were sterilized by the procedure employed, and steel instruments were not visibly altered.

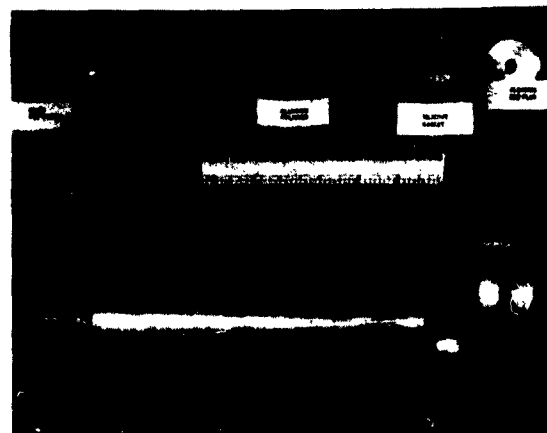


Fig. 1. Dental sterilizing cylinder: Identification of parts (A). Assembled, ready for instruments (B).

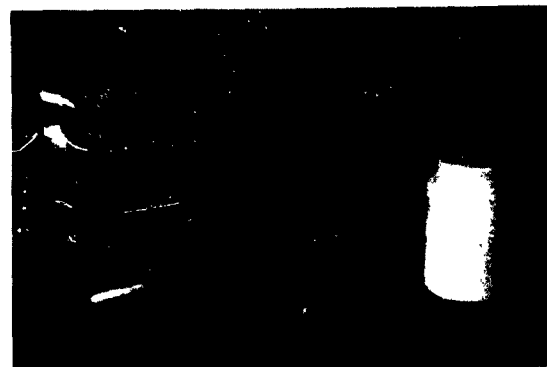


Fig. 2. Ethylene oxide container connected to opened petcock on cylinder.



Fig. 3. Cylinder ready for immersion in boiling water.

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